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PETROLOGICAL ABSTRACTS AND REVIEWS

EDITED BY ALBERT JOHANNSEN[1]

CLARKE, F. W. "Analyses of Rocks and Minerals from the Laboratory of the U.S.G.S.," *Bull. U.S. Geol. Survey No. 419.* Pp. 315. 1910.

Bulletins 220 ("Mineral Analyses") and *228* ("Analyses of Rocks") are combined in this edition and brought up to date. The conventional form of stating analyses is retained and the same method of treatment is followed. New Analyses: igneous rocks 56; sandstones, cherts, and sinters 21; carbonate rocks 39; slates and shales 3; soils, etc., 21; minerals 93. With these additional analyses there is a reduction of 169 pages which gives a large amount of valuable information in a small, compact bulletin.

CHARLES J. HARES

DALE, T. NELSON. "The Granites of Vermont," *Bull. U.S. Geol. Survey No. 404.* Pp. 133, pls. 5. 1909.

This work is a companion bulletin to those on the granites of Maine (No. 313), and of Mass., N.H., and R.I. (No. 354). Its method of treatment is both scientific and economic.

Part I. Geographically the granitic areas extend in a northeasterly direction between the central Green Mountain axis on the west and the Connecticut River on the east for almost the entire length of the state. The granites are of three types: (1) biotite granite, as that at Barre; (2) quartz monzonite, as that at Bethel; and (3) hornblende-augite granite—the "olive-green syenite" of Daly—as that from Mount Ascutney. The age of the Ascutney granite is placed as post-Carboniferous or pre-Cretaceous, that on the west side of Green Mountain as late Devonian or Carboniferous, and the traversing dikes as possibly Triassic. The author's conclusions are based largely on the works of Richardson and Daly.

Special points emphasized are: double sheeted structure, that is, a structure with horizontal jointing; compressive strain, which is illustrated by the elliptical shape assumed by the drill holes; schist inclusions; contact metamorphism (at Bethel the magma under pressure sent out stringers into the wall rock; at Barre, the constituent elements, quartz, feldspar, biotite, pyrite, apatite, etc., were injected as heated vapors along the cleavage foliation); orbicular texture in granite at Bethel—the nodules occur in sheets parallel to the flow structure and the major axes of the disks are parallel to the micaceous flowage bands; and delimonitization on the under side of the sheets of granite.

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Part II, while chiefly economic, touches on the general geology of the areas, gives petrographical descriptions of rocks, and economic details of the quarries. The work concludes with a bibliography of the literature on granites and a glossary of rock and quarry terms.

CHARLES J. HARES

DALY, REGINALD A. "Average Chemical Compositions of Igneous-Rock Types," *Proc. Amer. Acad. Arts and Sci.*, XLV (1910), 211–40.

Using Osann's "Beiträge zur chemischen Petrographie" and a few other sources, the average chemical composition of 98 principal igneous-rock types (excluding ascitic dikes) has been calculated. The results are shown in a table which also gives the averages for the same rocks regarded as anhydrous. These averages are of use in showing the chemical "center-points" in Rosenbusch's classification, the one in general use by the makers of geological maps. The averages furnish one of the bases for finally calculating the "average igneous rock." The relative uniformity in the soda percentage of the more abundant types is specially noted in its bearing on the origin of oceanic sodium and, therewith, on the problem of the age of the earth. The striking similarity of the average granite analysis to the average analysis of the base (ground-mass) in augite andesite, and the equally close resemblance of the average diorite analysis to the arithmetical mean of average basalt and granite are illustrated. The table of averages shows that the effusive rocks are more salic than the corresponding plutonics, helping to prove the justice of Rosenbusch's primary subdivision of igneous rocks into deep-seated types and surface lavas. The difference is explained genetically. Other special points in classification are noticed. The essential identity of the averages for pre-Cambrian and post-Cambrian granites is referred to the "anchi-eutectic" nature of the type.—(AUTHOR'S ABSTRACT.)

DALY, REGINALD A. "Origin of the Alkaline Rocks," *Bull. Geol. Soc. America*, XXI (1910), 87–118.

No alkaline province can be described as free from subalkaline eruptives, especially those of basaltic or granitic types. Emphasis is laid on the indisputable fact that the visible volume of all alkaline rock bodies is a very minute quantity as compared with the visible volume of subalkaline eruptive bodies. An inductive study shows that most alkaline rocks cut thick masses of limestones, dolomites, or other calcareous sediments. A long table illustrates the association. This fact suggests the hypothesis that the absorption of carbonate disturbs the chemical equilibrium of subalkaline magma in such manner that alkaline fractions are produced by differentiation. Most of the alkaline species are ascribed to the interaction of basaltic magma and limestone (or dolomite), but more acid magma is also sensitive to the solution of carbonate. The hypothesis explains the concentration of alkalies; the desilication shown by the crystallization of nephelite, leucite, corundum, etc.; the extreme variability of alkaline bodies in mineralogical and chemical composition; the occurrence of such lime-bearing minerals as melilite, scapolite, wollastonite, melanite, etc., and CO_2-bearing minerals as cancrinite and primary calcite. Suggestions are offered as to some of the chief physico-chemical reactions involved.—(AUTHOR'S ABSTRACT.)

GEORGE, R. D., State Geologist, and Others. *Colorado Geological Survey, First Report*, 1908.

The report contains the following papers: "The Main Tungsten Area of Boulder County," by R. D. George, with notes on the intrusive rocks by R. D. Crawford, pp. 7–104; "The Montezuma Mining District of Summit County," by H. B. Patton, pp. 105–44; "The Foothills Formations of Northern Colorado," by Junius Henderson, pp. 145–88; "The Hahns Peak Region, Routt County" (an outline survey), by R. D. George and R. D. Crawford, pp. 188–229.

"The Tungsten Area of Boulder County." The ores are found in veins in a region of biotite granite and granitic gneiss, the latter grading into quartz-mica schist and mica schist. These older rocks are cut by dikes and irregular bodies of granite and both coarse and fine pegmatite. In the northern and western parts of the district are many dikes which are described by R. D. Crawford as dacite, latite, latite porphyry, andesites of various sorts, diabase, basalt, basalt porphyry, lamprophyre, pyroxenite, and limburgite.

"The Montezuma Mining District." The schistose rocks are described as the Idaho Springs Formation and the Hornblende Gneiss Series. In the former, quartz, biotite, and sillimanite are the most abundant minerals, the most characteristic rock being called a mica-sillimanite schist. The igneous rocks include three types of granite, porphyries of various sorts, aplites, pegmatites, and a diabase. The ore deposits occur in several of these rocks but their genetic relationships are not determined.

"The Hahns Peak Region." The igneous rocks include effusive rocks and dikes ranging from rhyolite to olivine basalt, with plutonic diorite and gabbro. Quartz basalt is found in several dikes in the western part of the district. Extreme contact metamorphism is developed at the contact of the porphyries with the sedimentary rocks. E. R. LLOYD

HALLE, G. "Neuer Hand-Demonstrationsapparat für alle Erscheinungen der Doppelbrechung im Kalkspat," *Zeit. Kryst.*, XLVII (1910), 376–77.

Describes an apparatus for the demonstration of double refraction; the calcite prisms are smaller than those generally used, the desired effect being obtained by the use of a magnifying glass. For class work, the instrument is provided with a dicroscope and an aperture for mica wedge.

W. T. SCHALLER

LEISS, C. "Mikroskop mit gemeinsamer Nicoldrehung in vereinfachter Form," *Zeit. Kryst.*, XLVII (1910), 377–78. Fig. 1.

A simple arrangement, suggested by Dr. F. E. Wright, by which both nicols can be simultaneously rotated by means of a rigid vertical bar.

W. T. SCHALLER

MACKIE, WILLIAM. "The Distribution and Signification of Deviations from the Normal Order of Crystallization, also the Distribution and Significance of Micropegmatite in Granites, as Illustrated by the Granites of the North of Scotland." *Trans. Edinburgh Geol. Soc.*, IX (1909), 247–317. Diagrams 6, photomicrographs 8.

The author found in previous microscopic investigations of granites from the north of Scotland, that deviations from the normal order of crystallization existed in almost every rock-slide examined, and the occurrence of patches of micropegmatite was far more frequent than indicated in previous descriptions of such rocks. The present research was undertaken to obtain data as to the order of crystallization, the occurrence and distribution of micropegmatite, and, if possible, to arrive at some definite conclusions as to the origin and causation of the observed phenomena.

The author recognizes three kinds of micropegmatite: (*a*) intergrowths developed in the regular course of crystallization, (*b*) centric or radial forms developed in connection with and radiating from the edges of the feldspars, and originating in the reactions between the various minerals in contact with it, and (*c*) the form of micropegmatite presented by the matrix in which the other minerals are imbedded. From 182 slides examined, representing 90 different rocks, it was found that type *a* occurred in 23.3 per cent, *b* in 68.8 per cent, *c* in 13.3 per cent, and absence of any form of micropegmatite in 17.7 per cent.

In examining the sequence of crystallization the author found that any two minerals, whose periods of crystallization overlap, even where one of them is crystallizing at an abnormal period, may appear in micropegmatitic intergrowth; and the relative frequency of occurrence of any single pair in such combination is in proportional relation to the general coincidence of the crystallization periods of the particular minerals entering into the combination. Besides the usual intergrowths of quartz and orthoclase, the author found intergrowths of quartz and hornblende, orthoclase and hornblende, plagioclase and hornblende, sphene and hornblende, magnetite and hornblende, biotite and hornblende, quartz and biotite, orthoclase and biotite, plagioclase and biotite, quartz and plagioclase, orthoclase and plagioclase, quartz and microcline, microcline and plagioclase, quartz and sphene, plagioclase and sphene, orthoclase and sphene, biotite and sphene, quartz and epidote, and epidote and orthoclase.

All the phenomena are most readily explained on the theory of the origin of granite by crystallization from solution. The process is not always progressive, but at certain stages reversions come in and partake of the nature of re-solution of parts that had already become solid.

In conclusion the author gives in detail the various stages that appear to be indicated in the crystallization of a granite, and considering that the normal biotite granites have been derived by differentiation from a hornblendic magma, he gives the following stages for all granites: (1) At a temperature probably somewhat above 1,100° C., hornblende began to crystallize. (2) In supersilicated hornblendic magmas, quartz, orthoclase, and an acid plagioclase, or any combination of them, may appear along with the last of the hornblende, the appearance of these minerals in this connection being apparently due to their solubility in the originally liquid hornblende. (3) Partial resorption of these minerals, and in particular of orthoclase, may occur, apparently in consequence of the heat liberated by the crystallization of the hornblende. (4) Crystallization of sphene, sometimes simultaneous with, sometimes previous to, the hornblende, and in some cases even somewhat later, and at times around previously separated and partially resorbed quartz, orthoclase, and plagioclase nuclei. (5) Crystallization of biotite, with occasional resorption of hornblende—probably in consequence of, or at least aided by, the heat liberated by the crystallization of the biotite, with the subsequent separation of more quartz; but independently of this, quartz, orthoclase, and plagioclase may also appear in connection with biotite for the same reason that they appear in connection with the hornblende, viz., from solution in the originally liquid biotite. (6) Crystallization of plagioclase with occasional resorption of some of the biotite, with subsequent liberation of magnetite. (7) Crystallization in supersilicated magmas of part of the quartz, often as micropegmatite of the *a* type along with plagioclase, and later, in like manner, with orthoclase also. (8) Crystallization of orthoclase, with solution, in part, of the plagioclases, apparently from heat of crystallization of the orthoclase with subsequent development of micropegmatite of *b* type in the areas of solution. (9) Solution also, in part, of the earlier orthoclases during the crystallization of the later orthoclases, also with development of micropegmatite of *b* type in the areas attacked. (10) Crystallization of remaining portion of quartz with little or no action on the previously crystallized minerals. (11) Crystallization of microcline if present, with partial solution of plagioclases and orthoclases—the latter in limited degree—with subsequent development of micropegmatite of *b* type in the areas of solution. (12) Crystallization of remaining liquid magma, if any, with varying conditions, occasionally as micropegmatite of the *c* type, occasionally as microgranite.

ALBERT JOHANNSEN

NIKITIN, W. "Drehbarer Compensator für Mikroskop," *Zeit. Kryst.*, XLVII (1910), 378–79. Fig. 1.

Describes a sensitive instrument for measuring weak double refraction.

W. T. SCHALLER

NIKITIN, W. "Halbsphäroid zur graphischen Lösung bei Anwendung der Universalmethode," *Zeit. Kryst.*, XLVII (1910), 379–81. Fig. 1.

An apparatus to replace the stereographic net. Used in connection with a Fedorow Universaltisch, the optical constants may be directly drawn, with a pencil, upon the unglazed porcelain surface of the half sphere.

W. T. SCHALLER

NOBLE, L. F. "Contributions to the Geology of the Grand Canyon, Arizona, The Geology of the Shinumo Area, (continued), Part II," *Am. Jour. of Sci.*, iv ser., XXIX (1910), pp. 497–528. Pl. 1.

The writer gives a detailed description of the stratigraphy and lithology of the Unkar (Algonkian) rocks of the area. The sedimentary rocks consist mostly of alternating shales and quartzitic sandstones with some slate and considerable thicknesses of limestone.

The diabase intrusions described are of special interest. A sill of from 650 to 950 feet in thickness is intruded above one of the limestone members. Below this intrusive occurred large amounts of serpentine in bands and nodules. These show no trace of an alteration structure which might indicate a derivation from pyroxene, hornblende, or olivine. This fact and the fact that serpentine and asbestos are not developed within the diabase itself lead the author to believe that they are the result of contact metamorphism, conditioned by the invasion of the limestone by the diabase. The diabase itself consists primarily of plagioclase feldspar (near labradorite) and olivine in about equal amounts, with a subordinate quantity of augite and brown biotite. Ophitic intergrowths of augite and plagioclase occur throughout, and pegmatite dikes cut the mass.

At one point the rock at its upper contact is a pink hornblende syenite which appears to grade downward into the normal diabase. Transition specimens were not collected and the author's suggestion that the syenite is due to differentiation in place is only tentative.

A map showing the distribution of Algonkian rocks in the Grand Canyon region is appended.

ALBERT D. BROKAW

PARSONS, A. L. "Ein neues Sklerometer," *Zeit. Kryst.*, XLVII, (1910), 363–70. Figs. 2.

Describes a new instrument for measuring hardness, giving the construction and adjustments of the instrument and a few comparative results.

W. T. SCHALLER

RANSOME, F. L. "Notes on Some Mining Districts in Humboldt County, Nevada," *Bull. U.S. Geol. Survey No. 414.* Pp. 71. 1909.

These notes are based upon reconnaissance work. With the exception of a small portion, the field had been previously geologically mapped by the Fortieth Parallel Survey. In general, the granites described as Archean by that survey are intrusives in Mesozoic rocks; many of their Triassic quartzites are rhyolites, and thorough study would probably change many of the names applied to the igneous rocks. Some are pre-Tertiary, but most of them are Tertiary in age. Among the effusives are andesites, rhyolites, basalts, tuffs, and breccias. The granular rocks occur less abundantly. Those mentioned are granodiorites, hornblende-gabbros, diorites, monzonites, micaceous granites, granite- and diorite-porphyries.

The paper concludes with a list of minerals found in the district.

CHARLES J. HARES

SPITZ, ALBRECHT. "Basische Eruptivgesteine aus den Kitzbüchler Alpen," *Tscher. Min. Petr. Mit.*, XXVIII (1910), 497–534.

In the so-called Silurian schists of the Kitzebüchlian Alps, occur two groups of basic eruptive rocks. One group consists of undoubtedly effusive sheets and tuffs, interbedded with the schists; the other consists of isolated outcrops whose mode of occurrence is indeterminable.

The rocks described are monzonite-diabase, ordinary and olivine diabase, diabase porphyrite, hornblende diabase (proterobase), hornblende picrite, proterobase amygdaloid, albite-chlorite schist, and epidote-chlorite schist. The rock of greatest interest is the one to which the writer gives the name of monzonite diabase. With this term he wishes to designate all rocks which carry potash feldspar in greater quantity than is normal in diabases, but does not say that the amounts of orthoclase and plagioclase must be equal. Brauns and Erdmannsdörfer have previously described rocks which contain greater amounts of potash and which are transitional to essexites and theralites. The monzonite diabases differ from essexite- and theralite-diabases in the greater amount of SiO_2 in the former, so that they are sometimes quartz-bearing and are then related to Kongadiabase.

The plagioclase in the monzonite diabase is almost pure albite, which the author says is only comprehendable by considering it due to alteration. The potash feldspar occurs in part in irregular patches in the plagioclase, in part as interspaced filling. Much of it is peculiar in having a small axial angle, $2V=48°$, and in being optically positive. The pyroxene is enstatite augite (Mg-diopside of Rosenbusch), and is sometimes intergrown with brown hornblende. Ilmenite is present and there is much apatite. The texture is divergent-strahlig-körnig (Lossen's term for ophitic). The iron minerals and apatite were the oldest, and quartz and micropegmatite the youngest minerals to form. Pyroxene and feldspar are essentially of the same age, for they mutually inclose each other.

A chemical analysis of a quartz-free monzonite diabase from Weissenbachtal near Ellmau gives: SiO_2 49.86, Al_2O_3 13.01, Fe_2O_3 13.78, MgO 3.50, CaO 7.26, Na_2O 4.00, K_2O 1.66, H_2O 2.08, TiO_2 0.69, P_2O_5 0.38, CO_2 2.08=99.45. The rock is considerably altered and its computation is difficult. According to Osann's system it shows: $s=58.3$, $a=3.5$, $c=1.9$, $f=14.6$, $n=7.9$, $k=0.90$. It is related to the Kongadiabase of Hartenrod near Herborn, the diabase from Rocky Hill, New Jersey, the Hunnediabase from Campo Santo, the Hunnediabase from Halleberg, and the diabase from Richmond, Cape Colony.

(The rock is an alkali diabase or an orthoclase-albite diabase).

ALBERT JOHANNSEN

UHLEMANN, ALFRED. "Die Pikrite des sächsischen Vogtlandes," *Tscher. Min. Petr. Mit.*, XXVIII (1909), 415–72. Maps 1, figs. 17, photomicrographs 8.

The picrites here described occur in surface flows, dikes, and intrusive sheets, and are generally associated with granular diabases. The period of eruption began at the end of the Silurian and ended before the beginning of Middle Devonian.

The author particularly examined the relations between the picrites and the diabases, for, according to Rosenbusch, picrites are feldspar-free olivine diabases, and picrite porphyrites are feldspar-free melaphyres, and there are gradations from one to the other. The present study does not confirm this. An analysis was made of the normal diabase, another of the same rock near the contact, and a third of the picrite near the contact, and while there is an enrichment of magnesia in the contact diabase, this is explained by the assimilation of fragments of the picrite through which the diabase was erupted. The author believes that the cause of the association of diabase and picrite is not to be found in differentiation after eruption, but in intratelluric differentiation from a single magma.

In habit the picrites are coarse granular (½–2 cm.), more rarely medium-grained (2–4 mm.), pyroxene-olivine rocks, with less amounts of iron ores and apatite, and rarely basic plagioclase. Locally there is found primary biotite, rhombic pyroxene, or a globulitic and trichitic intersertal basis.

Two analyses of the picrites were made by the author and an older one from Gümbel is given for comparison. All of them are computed in Osann's system and the following formulae are found:

$$S_{44.8},\ a_0,\ c_1,\ f_{19},$$
$$S_{37}\ ,\ a_0,\ c_1,\ f_{19},$$
$$S_{42.1},\ a_0,\ c_1,\ f_{19},$$

which shows a remarkable resemblance between the three specimens from widely separated areas.

Three types of picrite are distinguished according to texture: (1) hypidiomorphic-granular (all the analyzed specimens belong to this group); (2) holocrystalline-porphyritic rocks with hypidiomorphic-granular ground-masses; and (3) hypocrystalline-porphyritic rocks with intersertal ground-masses.

Since such different textures are included among the picrites, the author proposes for the third type, from its occurrence at Altschönfels, the name of "Schönfelsit." In composition, Schönfelsite is a porphyry with closely crowded phenocrysts (persemic) of olivine and augite in a megascopically aphanitic ground-mass. Microscopically this ground-mass is seen to consist of rare apatite, aggregates of titaniferous magnetite, granular augite, long prismatic crystals of bronzite, automorphic laths of bytownite-anorthite (sometimes anorthite), and a gray or brown devitrified basis. The occurrence of basis in picrite is noteworthy and points to the effusive nature of the occurrence. This basis fills the interstices between the divergent laths of feldspar and also occurs between the pyroxene grains as a distinct interstitial filling. It is completely made up of fine scaly particles of a chloritic aggregate in which there still remain well-preserved trichites and globulites.

There are numerous secondary minerals found in the picrites described. They are tremolite, uralite, antigorite, bastite, pseudophite, pennine, delessite, prochlorite, talc, dolomite, siderite, epidote, kaolin-like products, and magnetite. ALBERT JOHANNSEN

TUTTON, A. E. H., *Crystalline Structure and Chemical Constitution.* London: Macmillan, 1910. Pp. viii+200, figs. 54. $1.50 net.

The title of this book is perhaps a little misleading, as it is not a general treatise on the subject, but is rather, as is stated in the Preface, an effort to present in a concise manner the author's original contributions to the subject of the relation between the form, structure, and physical properties on the one hand, and the chemical composition of the substances on the other.

The first four chapters are devoted to a historical sketch by way of introduction. The Haüy-Mitscherlich controversy on isomorphism is reviewed in its relation to more views on the subject. In a discussion of the periodic classification of the elements in its relation to isomorphism, the author digresses for a moment to decry the growing usage of oxygen = 16 instead of hydrogen = 1 as a basis for atomic weights. His reasons seem to be sentimental rather than practical, as chemists in general are agreed as to the advantages of the former.

After an instructive introduction to the study of isomorphous series the author proceeds to describe improved apparatus that he found it necessary to devise before his measurements could be made with the required precision. Perhaps the most important of these is a cutting and grinding goniometer. By means of this instrument it is possible to cut truly plane surfaces, oriented with almost mathematical accuracy. Either parallel-faced sections or 60° prisms may be cut by changing appliances. The instrument and its operation are described in detail.

A spectroscopic monochromatic illuminator for use in the study of the optical properties is substituted for the usual Na-light, K-light, Li-light, etc., with very satisfactory results. It involves little that is new in principle, though considerable ingenuity is expressed in the mechanical details. In a dilatometer for measuring the expansion of variously oriented sections, and in an elasmometer for the study of the elastic properties the well-known interferometer method of measuring minute distances is employed with gratifying results.

After describing his apparatus the author takes up a discussion of his own studies of two isomorphous series, namely the orthorhombic $R_2\overset{S}{\underset{Se}{}}O_4$ series and the monoclinic $R_2M\left(\overset{S}{\underset{Se}{}}O_4\right)_2 \cdot 6H_2O$ series, in which R may be potassium, caesium, rubidium, ammonium, or thallium, and M may be any one of a number of bivalent metals, though discussion is limited chiefly to the zinc and magnesium compounds.

The members of each series were submitted to a comparative study in regard to their external form and various vector properties, as refractive index, birefringence, and expansion coefficients. A number of these properties were shown to vary progressively when a heavier metal is substituted for a lighter, but apparently these variations do not bear any simple mathematical relation to the atomic weights. A marked divergence of the ammonium and thallium salts from the rest of the series is explained on the basis of their chemical differences from the true alkali metals. Similar progression, with a divergence in the cases of thallium and ammonium, is noted in the solubilities, but unfortunately the absolute solubility, in grams per liter, is discussed instead of the more significant molar solubility.

In the orthorhombic series the axes of the ellipsoid of thermal expansion were found to be coincident with the axes of the optic ellipsoid and in the monoclinic series one of the axes of the thermal ellipsoid coincides with the axis of symmetry, as might have been anticipated. It is unfortunate that the elastic properties of oriented sections are not discussed, as they would doubtless form an interesting addition to the subject.

The author's studies of crossed axial dispersion are presented in an extremely interesting chapter. A plate shows the crossing of the optic axes due to change in wave-length, the series of figures for two temperatures being given. Although it is not pointed out by the author, these figures show that for these salts the change in position of the optic axes for monochromatic light, with increasing temperature, is in the same direction as the change in position due to decrease in wave-length at constant temperature.

The author's conclusions are concisely summarized in the next to the last chapter. The new term eutropic series is defined as a series "in which the small angular differences and also the physical properties of the crystals obey the law of progression according to the atomic weight of the interchangeable elements which give rise to the series and belong to the same family group of the periodic classification." Thus the thallium and ammonium salts belong to the above isomorphous series, but are excluded from the eutropic series to which the potassium, caesium, and rubidium salts belong.

Because of the close similarity between the ammonium and rubidium salts the author concludes that there is unoccupied space within the latticework of the crystal to allow for the eight additional atoms when the ammonium radical is substituted for rubidium. This may not be considered as proven, as it rests on the tacit assumption that the dimensions of the atoms, or their spheres of influence are the same, an assumption which seems hardly warranted, especially in view of Pope and Barlow's interesting explanations of the same phenomenon.

In the concluding chapter a comparison is drawn of the present status of crystallography with that of twenty years ago when the author began his work as a pioneer in the field of the more refined measurements of crystallographic characters. He points out that the measurements recorded are now on a plane of accuracy with atomic-weight determinations, whereas formerly gross errors entered into a large part of the work. Bare mention is made of the work of Pope and Barlow and their valence theory.

The book is well worth the attention of everyone interested in crystallography whether from the chemical or physical side, and leads one to look forward to the author's more general treatise which is to appear shortly.

ALBERT D. BROKAW